Embodied Carbon

Challenges and Opportunities for Structural Engineers

By Donald Davies, P.E., S.E., and Kate Simonen, AIA, S.E.

Architecture 2030 (**architecture2030.org**) reports that, between now and 2060, growth in the world's population will require a doubling in the amount of building floorspace, equivalent to building an entire New York City every month for 40 years. Much of the carbon footprint of these new buildings will take the form of embodied carbon – the carbon emissions associated with building construction, including extracting, transporting, and manufacturing materials. As a result, owners, designers, engineers, and contractors are turning their attention to building materials and seeking information on these products so they can make more environmentally informed and smarter choices.

Structural engineers have an essential role to play in understanding and reducing embodied carbon. By mass and carbon footprint, structural materials are a dominant percentage of a building. Additionally, making structural materials, such as concrete, steel, or the harvesting and processing of wood, results in emissions. These emissions come from resource extraction, transportation, powering factories, and even the chemical reactions that take place during the manufacturing process.

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Structural engineers are experts at balancing performance criteria such as stiffness, strength, depth, and quantities. Adding in the assessment of embodied carbon is a natural fit for our profession. Two initiatives of the Carbon Leadership Forum provide opportunities for industry leadership in this area: the SE 2050 Challenge and the recently announced Embodied Carbon in Construction Calculator tool (EC3), a tool to help evaluate embodied carbon impacts.

The Carbon Leadership Forum issued the *Structural Engineers 2050 Challenge* (SE 2050 Challenge), stating, "All structural engineers shall understand, reduce, and ultimately eliminate embodied carbon in their projects by 2050." The goal of the challenge is to inspire structural engineers to contribute towards the global vision of Zero Carbon buildings by 2050, and to provide measurements of progress towards that vision. Much like the Architecture 2030 Challenge does for operational energy in buildings, this **SE 2050 Challenge** asks structural engineers to meet embodied carbon benchmarks and increasingly higher reduction targets in a race towards the most carbon-efficient buildings as we approach the year 2050.

The SE 2050 Challenge includes guidelines on best practices and an opportunity for individuals and firms to sign on in support. As of September, twelve major structural engineering firms and over fifty individual engineers have signed in support of the challenge.

The EC3 tool was created with input from a diverse coalition of more than 50 forward-looking and innovative building industry leaders including owners, architects, engineers, contractors, manufacturers, and industry organizations. A public beta of the EC3 tool was launched November 19, 2019, and initially focuses on:

- Structure: concrete, steel, timber
- Enclosure: aluminum, glass, insulation
- Finishes: carpet, ceiling tiles, gypsum wallboard

The EC3 tool enables the building industry to access and view material carbon emissions data easily. It also enables making this data actionable for more informed decision-making at different parts of the design process, and most importantly, at the time that structural material suppliers are brought on board for a project's construction. This is when double bottom-line decision making can best occur and be influential, when dollars are about to be committed. This free and open-source software will help users select materials based on embodied carbon. It will also help integrate material quantities and embodied carbon estimates together to create a whole building, embodied carbon "budget" to evaluate options during design, procurement, and construction. Users are able to evaluate "cradle-to-gate" emissions, those that take place before and during manufacturing up to when the product leaves the "gate" of the factory.

We all have a stake in improving how we move our industry toward a lower carbon footprint. Knowing project quantities, their embodied carbon impacts, and managing to a budget are best practice design principles and ways the structural engineer can help the client meet their project goals. Bringing both the SE2050 Challenge into your work and integrating the EC3 Tool into your project's design, specification, and procurement efforts build upon these principles and provide opportunities for demonstrating structural engineering leadership.

To learn more about embodied carbon, these initiatives, and the Carbon Leadership Forum, visit **www.carbonleadershipforum.org**. Learn more about the SE250 Challenge at **https://bit.ly/2Lk7bS2.** To register for access to the EC3 tool visit **www.buildingtransparency.org**.▪

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